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Environmental and economic return of Environmental Management Systems

Application of LiderA standard in energy cycle

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RETURN ENVIRONMENTAL AND ECONOMIC OF ENVIRONMENTAL MANAGEMENT SYSTEMS IN HOTELS.

APPLICATION OF STANDARD LIDERA IN THE CASE OF THE ENERGY CYCLE.

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ENVIRONMENTAL ENGINEERING MASTER THESIS, IST

Abstract

The hospitality industry is one of the most dynamic within the service sector and with a great evolution and expansion in the last years.

When it comes to hotel energy consumption important challenges such as the increase in competitiveness, the importance of cost reduction policies and the increasing sensitivity to environmental issues combine to create favourable conditions to the optimization of energetic resources and the introduction of renewable energies. The importance of energy savings is highlighted by the fact that its consumption represents the biggest part of current costs in a hotel, after costs with personnel.

This paper aims to assess the viability of the application of sustainable solutions and opportunities to improve the hospitality sector. Hotel Altis Avenida, in Lisbon, and its energy consumption were selected as the case study for this paper. The identification of measures and solutions to implement had as a support the leader (National System of Sustainable Construction Recognition). The economic assessment of the implementation of the analysed solutions was made using the life cycle costs and return period methods.

Out of the studied solutions and after an analysis of Hotel Altis Avenida's characteristics, the proposals to implement within the environmental performance continuous improvement process were divided in three parts, namely, Substitution Measures, Maintenance and Management Measures and Awareness Measures.

The solutions concerning substitution measures proceeded to an economic point of view analysis where it was concluded that they were viable, where current net value of costs and externalities (NPV) is positive. When it comes to the return period, the period in which the initial investment is recovered, we can verify that each of the viable economic solutions falls in an interval of 1 to 7 years at an interest rate of 6%. Considering the solutions in aggregate we get a return period of 5 years.

Lastly, this paper is written as a challenge at least in what concerns the economic assessment of the project through an ACCV approach with a goal of improving environmental performance.

Keywords: Environmental Return, Economic Return, Life Cycle Cost, Environmental Management System, Energy Cycle.

1 Introduction

1.1 Return Environmental and Economic of Environmental Management Systems in Hotels

The hotelier sector has important environmental impacts have been increasing to increasingly in many cases to look for consider and protect the natural environment where if it inserts since this is part of the central "product" that it offers to customers. [Pinheiro, 2006a].

In this direction, then comes a tool that makes it possible to improve their environmental performance, the Environmental Management System, which can be defined as a means to ensure that an organization, in all its operations and activities, corresponds to the environmental targets set by its policy that, in turn, relates to standards set by policy or other criteria [Chan e Wong, 2004].

In this sector, is more and more important to measure their economic performance than evaluating their environmental performance.

The market of sustainable solutions has grown worldwide and is likely to grow in the future due to the large environmental and financial return obtained by implementing sustainability measures, allowing the user to provide increased comfort and ensure an effective reduction in costs, due to improved process efficiency, and consequently, reduction in energy consumption and environmental impacts [Silva, 2006].

1.2 The Problem

The objective of this thesis is to analyze the potential environmental return, identify and suggest a set of sustainable solutions, including one of the parameters with greater economic importance in hotels, this is energy, for example, measures to replace equipment, management measures and customer sensibilization, in search of a good energy performance of a hotelier establishment, focusing on the contribution of the analysis of life cycle costs.

Then, the thesis is an approach the Environmental Management System, in view of the cost of lifecycle that they can raise intervention scenarios in the search for sustainability, which a simplified approach doesn't make.

1.3 Methodology

In a first face, it proceeds to review the literature on Environmental Management System, including their environmental and economic returns in the energy cycle applied to the hotel sector and some challenges and best practices in environmental performance and energy.

After, makes up the systematization of the characteristics of hotels, and selects a case study. In the case study are made surveys of data on the activities and costs associated with the requirements and energy consumption, in which the scope of the thesis was conducted a survey of all the detailed individual equipment that consume energy, well as a model to estimate the values of consumption and usage standards.

Aftermost, solutions are identified and improvement opportunities to apply in the area of energy.

Once defined the set of solutions, we proceeded to the analysis of the costs associated to its implementation, namely, your payback period. Finally,

we performed a critical discussion of the approach and results, and their potential application in the tourism industry.

2 State of the Art

2.1 Environmental Management Systems

The Environmental Management Systems implementation appears as a global trend since there is a great need to perform against sustainable development, which leads to the reduction of costs and improved quality of life of the organization [Chan e Wong, 2004].

It is a system created to implement and monitor the activities of environmental protection. The guidelines by which to guide are: organize, plan, assign responsibility, provide human and material resources, and determine the procedure to meet an environmental policy and performance expectations, according to the requirements of ISO 14001. [Melnyk, Sroube e Catantone, 2003].

The hotel managers know that Environmental Management Systems implementation is learning processes where problems and errors arise that need to be detected and resolved in a continuous manner.

2.2 Return Environmental and Economic of Environmental Management Systems

The preservation of the environment is a commitment, if implemented; it can be very lucrative for hotels, as an environmental and economic level. [Schenini, Lemos e Silva, 2013].

2.2.1 Environmental Performance

The objectives of the energy performance of a building relate are to:

- Maximize comfort levels;
- Maximize the indoor air quality;
- Increase the energy efficiency of buildings;

The Energy Performance of a European building is known as dependent on four factors: urban context, building design, efficiency of systems and occupant behavior. The importance of each one varies in each area, criteria and situation. [Pinheiro, 2006a].

In the case of hotelier, the occupants are also customers who, by requiring a high level of comfort, may have irresponsible behavior. Therefore, doesn't serves to have a building with a sustainable construction, if the occupants do not have sustainable behavior, it is necessary to intervene in the sensitization of the customers.

2.2.2 LiderA

LiderA is the Portuguese system for sustainability environmental assessment of built environment [LiderA, 2013].

This system develop by Prof. Manuel Pinheiro results from research and projects on sustainability in construction and built environments, made since 2000, which led to the publication in 2005 of the first version and in 2007 the first certifications [LiderA, 2013].

The LiderA system - Hotels, intend to facilitate the integration of sustainability principles in units and building hoteliers and their evaluation and certification of its performance in this scope.

2.3 Life cycle cost and Return Economic

The analysis of an investment is intended to study the entire capital invested in a particular project and mapping its future results.

The analysis of the economic benefits usually based on calculating a set of parameters [Leckner e Zmeureanu, 2011]:

- Net Present Value (NPV);
- Internal Rate of Return (IRR);
- Payback Period;

2.4 Energy Cycle

One of the aspects to consider in any project involving Energy it's yours cycle.

In the Portuguese energy viewpoint, the inputs in the production of energy are fossil fuels and renewable energy. One of the main outputs of energy production and consumption is the emission of greenhouse gases, mainly CO2, the main cause of climate change.

The increasing of energetic necessity along with the need to reduce CO2 emissions associated with the consumption, lead to the search for mechanisms to reduce energy effectively consumption, to increase energy efficiency and to promote renewable energy use in this sector [Pinheiro, 2006a].

In recent years, there is a major European Directive, relatively buildings energy efficiently, the initiative 20.20.20, and the launch of the Energy Efficiency and Endogenous Energies [E4, 2002], known for E4 Programmer.

3 Performances and Good Practice International

Studies about the energy performance and carbon in the hotels have come to be published of doubtful form and by comparative times.

Among the good examples studied stand out the hotel Scandic and NH hoteles due to their best practices and their performance values.

The Scandic hotels are one of the main chains of hotels of the north of the Europe, and one of the well-succeeded hotelier chains in Europe. On the other hand, the NH hoteles are one of the 25 bigger hotelier nets of the world.

Table 1 Scandic e NH hoteles Environmental Performance.

		Units	Best Practices
Scandic	Energy	kWh/guest/night	38.87
	Carbon emissions	kg/guest/night	0.27
NH Hoteles	Energy	kWh/guest/night	35.9
	Carbon emissions	kg/guest/night	8.1

The good energy and carbon performance of these two hotels, can be serve as basis of awareness, by all those involved in the hotelier business, in relationship to the importance of energy management and, consequently will adopt programs and measures aimed at energy efficiency.

4 Case Study

The case study used in this thesis is the Altis Avenida Hotels. The reason to choose this case is the fact that already classified by the system LiderA but in the process of certification, which was looking for a good environmental performance and implementation of good environmental practices.

4.1 Description of the Hotel

The Hotel Altis Avenida takes place in a building classified representative of Portuguese Modernism, by the architect Cristino da Silva, which was severely degraded and that was the target of a deep rehabilitation for the creation and installation of hotel, which opened in March 2010.

This hotel comes with a charming cosmopolitan five stars in Lisbon, that has a prime location in the city center with an area of deployment of 557.12 m2, standing on December 1st Street, next to the Restauradores.

The hotel is composed of 9 floors, adding these to the engine room on the roof and has 70 rooms, 2 of which are suites, a meeting room and a restaurant with terrace on the rooftop.

4.2 Description of Energy Consumption

The Altis Avenida Hotel consumes energy in two different forms of energy, electricity and gas use in the following uses:

Table 2 Final Energy Use.

Forms of Energy	End Use
Electricity	Lighting, air conditioning, ventilation, mechanical power (pumps, elevators, etc...), heating (furnaces, water baths, dryers etc...), refrigeration equipment, miscellaneous equipment (audiovisual, office, laundry, etc...), refrigerators;
Gas	Boilers (Heating Environment, Domestic Hot Water (DHW) and steam production) and kitchen (food confection);

Since the hotel did not have a rigorous and detailed survey of energy consumption in various end users and major equipment, in the scope of the thesis a survey was conducted of all individual equipment (more than 300) that consume energy, well as a model to estimate the values of consumption and use standards, which became the main working tool, indispensable to the realization of this work.

According to the methodology used in the study distinguished five distinct phases:

1) Identification of **divisions / areas** of the hotel.
2) Detailed survey of all the elements that were present (equipment, lights, etc...) as well as their respective **quantity and power (W / unit).**
3) Assessment and registration of **periods of operation (h / day)** of the respective elements.
4) Weighting an occupancy rate for rooms.
5) Consideration of **factor of use** and yet the **Hypothesis value well in excess** to ensure the accuracy of the surveys.

Identified and quantified the energy consumption in various end users and major equipment, it was possible to characterize the main energy consuming areas of the hotel.

The Figure 1 represents the distribution of consumption by the end user of Altis Avenida:

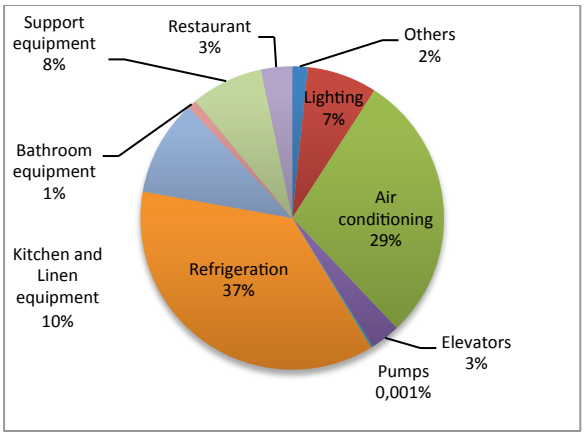

Figure 1 Distribution of energy consumption by end use in the baseline scenario.

4.3 Measures/ Solutions to Implement

Appealing to the existing technologies and in agreement with the criteria of the LiderA system to the measures and solutions are identified to implement.

Each solution concerns an opportunity for reducing energy consumption, and also, an opportunity to increase the environmental performance of the Hotel. The measures referred to is to consider the following:

- Measures of Replacement;
- Measures of Maintenance and Management;
- Measures of Sensibilization;

Table 3 Measures of replacement aimed at reducing energy consumption and promoting the use of renewable energy.

Measures of replacement	Description
System Monitoring and Control	–
Glazing - with high sun protection	Area glazed - was accounted the glazed area will corresponding Reception, Conference Room, Restaurant and Rooms.
Outdoor blinds	Equivalent to the area of bedroom windows.
Household-electric of low consumption and efficient	–
Energy-saving lamps	Are included the Reception, Conference Room, Bedrooms, Kitchens, Restaurant, Offices, Corridors, Terrace, Laundry, Bathrooms.
Wind Power	Able area of occupancy (considering the use of other renewable energy sources) - The choice of location was based on sun exposure and ease in placement of these, so the cover appears as the best option.
Photovoltaics	
Solar thermal collectors	

Table 4 Measures of Maintenance and Management aimed at proper management and maintenance of facilities and equipment to reduce energy consumption and maximizing the efficiency of equipment.

Measures of Maintenance and Management	
Environmental Objectives	**Actions**
Minimize energy consumption	**Lighting:** • Perform proper maintenance of the electrical installation, including the lighting system. **Climate:** • Optimize the temperature in the common spaces within the acceptable limits of comfort, taking into account the outside temperature to minimize energy consumption. • Turning off the air conditioning in unused areas. **Kitchen and Laundry:** • Whenever possible, dishwashers and washing glasses should operate only at full load. • Program the defrost cycles for periods, daytime or nighttime, they do not coincide with the peak consumption associated with electrical heating. • Perform periodic cleaning of the surface of the heat exchanger in the cold storage, preventing the formation of ice in the evaporator.
Improve equipment efficiency energy users	• Regularly inspect production systems for heating and cooling to ensure a good efficiency. • Improve the efficiency of the cooling tower, including through periodic maintenance.

Table 5 Measures of sensibilization aimed at raising sensibilization among employees and customers contributing to the optimization of processes, terms productive and rational use of energy.

Measures of Sensibilization	
Environmental Objectives	**Actions**
Minimize energy consumption	• Providing information to all guests and employees about the consumption of electricity and respective savings achieved as a result of efficiency measures implemented. • Environmental reminder to guest's rooms. • The hotel must provide information and training to its employees, including written procedures or manuals, to ensure the application of environmental measures and to raise awareness regarding environmentally friendly behavior.

5 Applications of Measures and Opportunities for Improvement and Evaluation

In this phase of the study, we intend to perform the validation of alternative measures identified in the previous chapter. In response to the proposed objective, validation of the proposed improvements focused mainly on two parameters: the saving of energy consumption and the period of financial return of its use.

The procedure performed to calculate the costs and respective return period associated with each solution is presented in Figure 2.

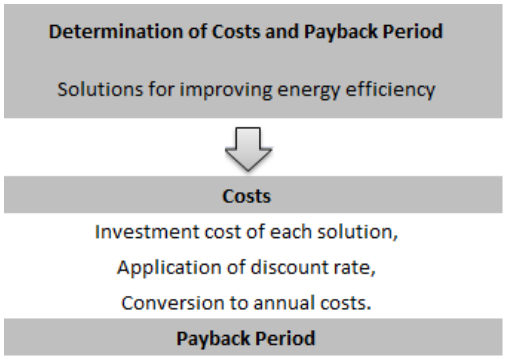

Figure 2 Procedure for the determination of costs and payback periods under review.

For the solutions analyzed, it is assumed a time horizon of 20 years (except for lamps) and a discount rate of 6%, applied to the analysis of life cycle cost.

For each solution to be implemented and by contacting the suppliers were obtained budgets and technical data most relevant to the calculation of the investment cost of the same.

However, when you want to perform an economic analysis of a given project is necessary to take into account the externalities generated by the project.

With a positive externalities a benefit is associated while a negative externalities is associated a cost/damage.

In this case, attempts to assess the positive environmental externalities in the electricity sector, that is, the social benefit associated to reduction of electricity consumption after the implementation of the proposed solutions.

The social benefit is divided into private benefit and external benefit.

The private benefit is associated to reduce electricity bill and it is calculated by the following expression:

- $\boldsymbol{Private\ Benefit} = \%\ Energy\ Reduction \times Total\ Cost\ of\ Electricity$

The benefit comes from the reduction of electricity consumption is accounted for by ExternE, a methodology that estimates the external costs generated by the cycles of fuels used to produce energy.

- $\boldsymbol{External\ Benefit} = \%\ Energy\ Reduction \times Total\ Electricity\ Consumption \times \sum(e_i \times f_i)$

Where,

e_i - Externalities;

f_i - Fraction;

Taking into account the investment costs and the economic value of externalities associated will reduce energy consumption, can proceed to the analysis of the Life Cycle Cost of the solutions analyzed.

The calculation of the payback period was made to all solutions analyzed.

6 Discussion of Results

Through the approach performed confirms that the application of the proposed improvement measures allows significant reductions in energy consumption and an improvement in the environmental performance of the hotel.

It also proves that there is economic viability assessment of the project is made by a method of approach to life cycle cost, therefore beyond the ambient benefits also economic benefits are verified.

The Table 6 presents the main results obtained for each identified solution and aggregation of solutions through the analysis of case study, with regard to measures to improve, that reflecting the savings in energy consumption and payback period of the introduction of new measures.

In a first comment it is possible to evidence that the project is viable, that is, all the analyzed solutions contribute inside for the reduction of the energy consumption of the hotel of the defined time horizon (20 years).

The difference of the period of return of the investment of each solution is not very accented, and is of low level what it becomes this quite optimistic project, since that the biggest period of return is of 7 years. This is because the investment is recovered in a short period of time.

When this analysis is extended to the set of all the solutions is verified that its implementation in simultaneous results in a period of return of 5 years, a discount rate of 6%.

All individual and aggregated solutions is important to note that none is uneconomical, since there are no costs outweigh the benefits, which is reflected in VAL always positive.

Also there is not any identified solution that presents a period of recuperation of the very elevated investment and therefore, we always have periods of return inside the time horizon respected and quite appellative.

Table 6 Summary table of the analysis of individual and aggregated solutions.

Solutions	Investment Cost (€)	Externalities - Social Benefits (€/years)		VAL [6%] (€)	Payback Period [6%] (years)
		Private Benefit	External Benefit		
System Monitoring and Control	12 500	3 197	697	32 159	4
Glazing - with high sun protection	65 740	9 271	2020	63 771	7
Outdoor blinds	26 900	11 126	2424	128 513	2
Household-electric of low consumption and efficient	11 600	6 074	1 323	73 252	2
Energy-saving lamps	4 964	3 517	766	15 0475	1
Solar thermal collectors	28 500	12 788	2 786	15 0136	2
Wind Turbines	8 400	2 877	627	31 793	3
Photovoltaic Modules (17%)	57 984	10 870	2 368	93 857	5
Photovoltaic Modules (46,2%)	158 976	29 541	6 436	253 673	5
Aggregate solutions (100%)	317 580	63 941	13 931	575 600	5
Aggregate solutions (71%)	216 588	45 398	9 891	417 570	5

Relatively, the possible limitations/ uncertainties error in LCCA relate to the lack of available and reliable data for the choice of the various parameters of the analysis, both in terms of costs, performance data and calculating the externalities.

7 Conclusion and Future Works

The issue of energy saving, particularly in the hotelier sector, makes it necessary to adopt new and more efficient solution in order to obtain the advantages that the proposed process efficiency.

On the other hand, solutions should also contribute to an effective reduction in consumption, that situation should therefore be assessed and quantified ensuring that its outcomes could serve as a reference for future interventions.

In this context, comes the main objective of the thesis: cost analysis in the life cycle may be applicable and useful in the environmental management system, in finding a good energy performance.

The real challenge is to analyze the costs in a balanced perspective in their life cycle, more than just think about the cost of investment. When we can save energy, to increase the durability, to save water and, at the same time, to increase the productivity, the characteristics of sustainability of the project are very easy to justify.

Applying this concept in the case study of Altis Avenida Hotel, and given that the hotel does not have a rigorous and detailed survey of energy consumption in various end users and major equipment, in the scope of the thesis the equipment was effected an individual survey of all that consumed energy, and a model to estimate the values of consumption and usage patterns, which became the main working tool, indispensable to the realization of this work.

N Of course it is not enough to have the equipment, it matters to have a way of maintenance and management and sensitization of the behavior of the users, nominated, of the employees and customers of the hotel. It is known that the procedures of the staff of kitchens, laundries, etc.., are not always the most appropriate, sometimes leading to significant waste of energy. It is therefore important to take account of this problem, in order to contribute to the optimization of processes, both in terms of production, and both for the rational use of energy.

The analysis of this study case study allowed establishing orienting lines of procedure as for the proposals of improvement of energy efficiency with greater potential for the application of the hotel.

In this way, one expects that the carried through work assists a project of renewal of the Altis Avenida Hotel contributing for its good energy performance and that this case study is a reference for the incentive to the sustainable development of the tourism in Portugal.

With interest to be held in the future to increase knowledge, for example, is to perform the following studies:

- Analysis of how we evolved in terms of their energy consumption, as will likely happen;
- Establishment of methods for predicting the lifetime of the elements accurately;
- Breakdown of energy consumption by the amount of air conditioning in winter and summer, since consumption will be higher in winter because the heating requirements are higher.

- Determination of study periods and discount rates more appropriate to adopt an analysis LCC;
- Looking for an approach to the analysis LCC allowing the inclusion of non-tangible costs in the study;

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